

Trauma Rounds

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San Francisco General Hospital*

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Management of Liver Trauma

JOHN WILSON, MD:* The Trauma Service would like to present two cases of liver injury today. The first patient was a 19-year-old student, a young man who was involved in a motor vehicle accident while driving without a seat belt. Thrown against the steering wheel of the car, he received blunt trauma to the chest and abdomen. When admitted to the emergency room 15 minutes after the accident, the patient was alert and conscious, with complaint of pain in the right upper quadrant of the abdomen. Blood pressure was 170/78 mm of mercury. The patient had no difficulty in breathing. On physical examination, the abdomen was flat and minimally tender in the right upper quadrant and the epigastrium. Multiple superficial lacerations of the head and neck were noted. The hematocrit was 42 and the urine was clear. Results of neurological examination were within normal limits.

The patient's condition was felt to be stable but in the course of x-ray evaluation he sat up for a chest film and the blood pressure fell to 66 mm of mercury systolic. A saphenous vein cutdown was added to an earlier cutdown in the antecubital fossa. After administration of two liters of Ringer's

lactate solution, the blood pressure rose to 90/70 mm of mercury. The patient was taken to the operating room for exploratory laparotomy.

The second patient was a 32-year-old woman who fell down several flights of stairs two days before admission. She noticed malaise, loss of appetite, nausea and vomiting on the day following injury. Two days later she was admitted to the San Francisco General Hospital. Her blood pressure was 170/110 mm of mercury and the pulse 88. On physical examination, increased abdominal girth and abdominal tenderness were noted. The hematocrit was 17. She was taken to surgery shortly after admission.

JOHN KNUDSON, MD:† At laparotomy, in the first patient, approximately 1,500 ml of blood was present in the peritoneal cavity. There was a through-and-through laceration of the liver, passing obliquely upward from the falciform ligament to the vena cava at the level of the diaphragm (Figure 1). There was active bleeding from this site and each attempt to retract the liver resulted in a major gush of blood. By judicious placement of a pack, bleeding was controlled. Fluids were administered rapidly by the anesthesiologist and normal blood pressure was restored. A modified left lobectomy was done to expose the area of bleeding. Bleeding was found to originate for the

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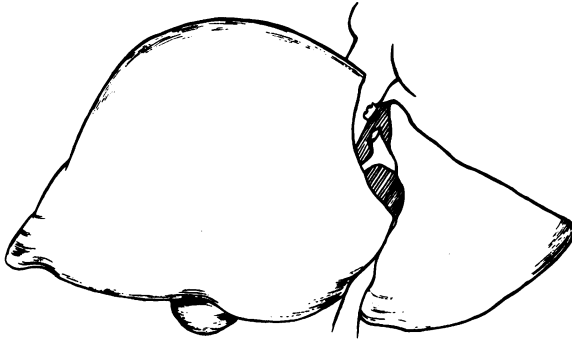


Figure 1.—The liver injury in patient 1, showing avulsion of the left hepatic vein from the inferior vena cava.

most part from the left hepatic vein where it was torn from the vena cava. Once the hepatic resection was completed, exposure of the inferior vena cava was possible, permitting repair of the hole in the vessel. The middle hepatic vein, which communicated with the left hepatic vein, was ligated. Further hemostasis was carried out by suture ligation of bleeding points in the raw surface of the liver. The hepatogastric ligament was sutured so as to cover the raw surface of the liver.

The second patient was originally thought to have had rupture of the spleen but at operation a large subcapsular hematoma (Figure 2) was found. Approximately 1,000 ml of blood was present in the peritoneal cavity. The hematoma was an inch thick and covered the entire left lobe, centering on the falciform ligament. The liver capsule was removed, revealing a deep laceration of the left lobe of the liver. The lateral lobe was resected. Hemostasis was difficult because of continued oozing from the raw surface of the liver. Large Penrose drains were placed before the abdomen was closed.

F. WILLIAM BLAISDELL, MD:* *Did you use any kind of hematologic support in these patients?*

DR. KNUDSON: The second patient was never in shock, and blood loss preceded operation by several days. Bleeding from the Penrose drains stopped spontaneously soon after the abdominal closure. The young man required 14 units of blood during operation. We gave him fresh frozen plasma and platelet transfusion, in addition to blood, in anticipation of bleeding problems and this apparently prevented any bleeding difficulties. We re-explored the next day because we were

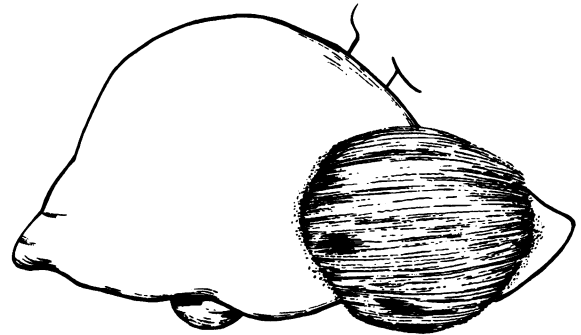


Figure 2.—A large subcapsular hematoma found in patient 2.

concerned about the viability of the liver. On re-exploration, the liver looked satisfactory and the abdomen was dry.

DR. BLAISDELL: *I would like to introduce our department's visiting professor of surgery, Dr. Walter Ballinger. Dr. Ballinger is Bixby Professor of Surgery at Washington University, St. Louis, and he has written extensively on trauma. Dr. Ballinger, would you please use these cases as a basis for discussing the management of liver injuries?*

DR. BALLINGER: These problems show that we can have delayed manifestation of liver injury and how subtle these injuries can be. The management of liver trauma has swung progressively from ultra-conservative to ultraradical and is now swinging back toward middle ground. We are attempting to differentiate between various types of liver injuries and to apply specific treatment for each. Liver resection should not be necessary in more than 5 percent of all liver injuries.

The basic questions are when to drain, when should the liver laceration be oversewn and what are the indications for resection? Most liver lacerations are superficial injuries, and undoubtedly a good number are never diagnosed or treated specifically. The amount of bleeding is at most several hundred milliliters. These superficial lacerations should simply be cleaned up and the liver carefully assessed. No attempt should be made to close them, and after peritoneal toilet is completed, drains should be placed in the vicinity of the laceration and the subhepatic space and the abdomen then closed.

If the laceration is still bleeding at the time of laparotomy, the depth of the laceration should be investigated and bleeding points secured by suture ligation. With good light and suction, combined

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with an arterial clamp placed temporarily on the portal triad, the area can be cleaned up so the bleeding point can be seen and secured. These deep lacerations should not be closed but rather left open to drain. The use of deep mattress sutures is to be decried because they either compromise more liver anatomy or produce a closed space in the liver. This sets the stage for hematomata and liver abscess.

Most deep lacerations can be controlled conservatively and unless there has been major avulsion of the liver or devascularization of a lobe or segment, we would attempt to avoid resection if at all possible. For the type of injuries presented here today, there is no question that circumstances dictated resection. The first case was a real challenge because the left hepatic vein was avulsed from the vena cava. This patient was particularly lucky to have been treated here. Most such patients are dead by the time they reach the operating room. Even if they live long enough for laparotomy to be done, there is great difficulty in controlling the hemorrhage. We have yet to save a patient who has significant avulsion of hepatic vein from the vena cava. We have not been able to use the bypass which permits isolation of injuries of this type. The injury in the first case was the most serious kind of liver damage a person can have. The surgeon must know his anatomy well to avoid compromising all of the hepatic venous drainage.

The second patient was much less of a problem. She clearly benefited from the left lateral lobectomy, which is the easiest type of resection to do.

Nothing is more important than the decision to re-explore when the viability of the liver is questionable or when initial control of bleeding is not adequate.

Despite the negative findings at re-operation in the first patient, the nature of the injury was such that I think the decision was the proper one.

DR. BLAISDELL: *Dr. Ballinger, would you comment on the use of common duct drainage in liver injury?*

DR. BALLINGER: In the past we did use T-tubes more or less routinely. The studies by Lucas in Detroit tend to indicate there is more risk than benefit in the use of T-tubes. I would not abandon the use of the T-tube completely, but I would use it only on those infrequent occasions when there is a complicated injury and when I might wish to

evaluate the liver postoperatively with cholangiography.

DR. BLAISDELL: *Dr. Ballinger, do you have any specific comments on subcapsular hematoma?*

DR. BALLINGER: Many people have the opinion that subcapsular hematoma is a relatively benign lesion. The second case is a good example of how the liver can be crushed by a blunt traumatic injury and yet the capsule remain intact. The intact capsule and hematoma obscure the real extent of the injury which may lead to delayed rupture and, of course, intrahepatic abscess. When you see a subcapsular hematoma, there is probability of a serious disruption of liver substance underneath the hematoma. Therefore, the capsule should be opened and the hematoma cleaned out. Any bleeding vessels should be ligated in the depth of the laceration, or resection done if the liver is badly traumatized.

DR. BLAISDELL: *Dr. Ballinger, we would like to get your comments about the postoperative management of these patients.*

DR. BALLINGER: *How long was the clamp on the portal triad?*

DR. KNUDSON: About twenty minutes.

DR. BALLINGER: What we are balancing is the condition of the liver, versus the ischemic time, versus the temperature. The question is how adequate is the reserve of the liver that we are going to leave behind? All these variables have to be taken into consideration. If I were dealing with an older patient with a complicated injury, I would probably try to use icewater lavage in an attempt to get some protection and decrease ischemic damage. In these circumstances, it is possible to lengthen ischemic time from about thirty minutes to perhaps forty-five minutes or an hour. When we are dealing with young patients such as those presented here, whose livers are in good shape, we probably would not be concerned about ischemic damage in the postoperative period.

When you have hepatic venous disruption, it is mandatory to ensure adequate exposure. Can you describe the incision used in the first case?

DR. KNUDSON: Initially, we made a midline incision. When the difficult nature of the injury was recognized, we did carry the incision into the chest with a median sternotomy. After cutting the fibers of the diaphragm, we had excellent exposure.

DR. BALLINGER: *I would like to ask what your experience with the total hepatic bypass has been, Dr. Blaisdell?*

DR. BLAISDELL: We have used this now in approximately 12 instances and have three survivors of suprarenal vena cava injury or hepatic vein avulsion. One of the problems is that by the time you are mentally prepared to use it, the patient has exsanguinated. We still favor cannulating the left atrium but the inferior vena cava route can be used. Approximately fifteen survivors have been reported in whom a vena cava shunt was used with complete vascular isolation of the liver.

ROBERT C. LIM, JR., MD:* *I'd like to ask Dr. Ballinger if he has any experience with hepatic artery ligation.*

DR. BALLINGER: One of the important advances made by Mays has been to show that hepatic artery ligation can be used selectively in certain cases of trauma to the liver. It offers promise of being of greatest value in penetrating injuries—in those in which there has not been much damage to liver substance but which may produce hemorrhage which is difficult to control. In these circumstances, selective ligation of a hepatic lobar artery may permit control without having to carry out a major resection.

DR. LIM: We have used hepatic ligation in seven patients. At various times, we have ligated the hepatic lobar arteries, the proper hepatic artery and the common hepatic artery. In the latter two instances, it is important not to damage collateral flow. All of our morbidity from hepatic artery ligation has occurred in patients who had mobilization of the liver with corresponding obstruction of capsular collaterals.

We have done laboratory experiments in which xenon clearance studies showed that glucagon augments liver blood flow. As a result, we use glucagon to support the liver until collateral flow improves. We give this in doses of 2 mg intravenously every four to six hours. This is particularly of value to patients in whom we ligate the

hepatic artery for bleeding or in whom extensive resection has been done.

DR. BALLINGER: Another advantage of glucagon is that it has a favorable effect on the heart and improves cardiac output.

DR. BLAISDELL: *Dr. Ballinger, do you have any strong feelings about how the drainage should be carried out?*

DR. BALLINGER: We would err on the side of putting in too many drains in too many places. We would like to drain the suprahepatic space, the infrahepatic space and the area of the laceration. The drain should not be put into the liver laceration but adjacent to it. Then a good-sized opening should be made in the abdominal wall in as dependent a position as possible and the drains brought through. Ordinarily, we would just use regular Penrose drains, although a sump drain might be of value in selected patients with complicated injuries.

DR. BLAISDELL: Dr. Ballinger, we wish to thank you for a very informative session. I would like to summarize the main points you stressed today—all of which I agree with completely. Most liver injuries can be managed by conservative means. Liver resection can be avoided in all but perhaps 5 percent of liver injuries. It should be reserved for major devitalizing injuries or injuries involving hepatic veins and when there are no alternative means to control bleeding. The bleeding from most lacerations has stopped by the time exploration is done, or it can be controlled by suture ligation of the bleeding points. Through-and-through mattress sutures should be avoided because they devitalize liver tissue or create a dead space which sets the stage for abscess formation or complications such as hematemesis. Good drainage of liver lacerations is essential and this should be dependent so that a large opening can be made in the abdominal wall without danger of evisceration. Selective ligation of a lobar artery or, if necessary, of the common or proper hepatic artery, can be used in instances when there is major inaccessible bleeding. This can be accomplished with less risk than major lobar resection.

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